

Integrated Procedures for Flight and Ground Operations Using International Standards

John Ingalls

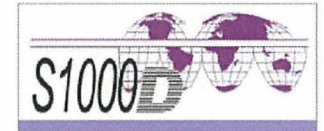
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About the Author

- **John Ingalls, United Space Alliance, LLC (USA)**
 - Senior Engineer, Launch & Recovery Systems
 - S1000D USSMG (U.S. Specification Maintenance Group)
 - International Specification for Technical Publications
 - AIA's SSFA (Strategic Standardization Forum for Aerospace)
 - AIAA Senior Member



- **About USA**
 - Joint venture, Boeing and Lockheed-Martin
 - Numerous services and products for space and defense
 - John is from the Florida division at NASA Kennedy Space Center



Outline

- **Introduction**
- **Ground Processing Technical Publications**
- **On-Orbit Technical Publications – Shuttle**
- **On-Orbit Technical Publications – ISS**
- **Optimization Via S1000D Standard**
- **Space Industry Opportunities**
- **Integration Via Global Standards**
- **Conclusion**

Introduction

Organization of Technical Data is Key to Efficiency & Safety

According to 2006 study of information/knowledge workers' time spent:

48 % – searching (9.5 hours/week) & analyzing (9.6 hours/week) information.

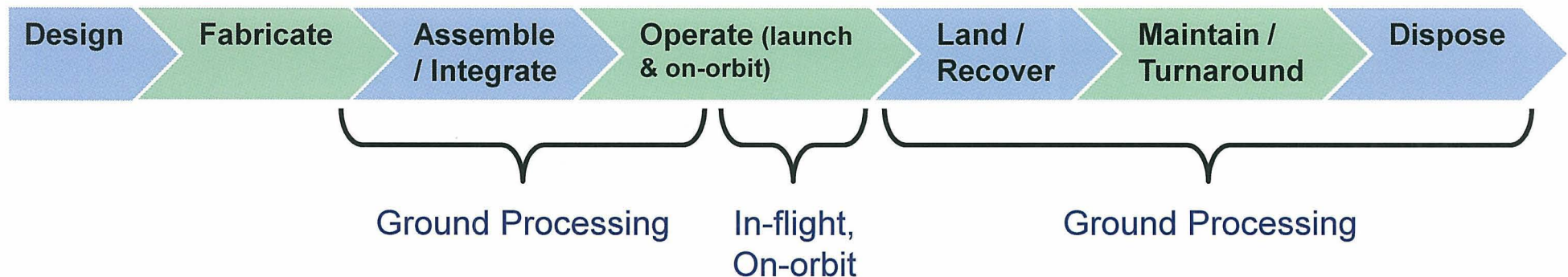
3.5 hours/week – in unproductive searches (info not found).

3 hours/week – recreating content that already exists.

- **Technical Data**
 - Part of Integrated Logistics / Product Support (ILS / IPS)
- **Technical Publications (“Tech Pubs”)**
 - Procedures and manuals
 - Paper-based and non-interactive electronic documents
 - Interactive Electronic Technical Manuals/Publications (IETM / IETP)
 - Database-oriented paperless procedures
- **Space Industry Tech Pubs**
 - Used in ground processing
 - Used in-flight / on-orbit
 - Often unique types/sets for each program, mission, element

Ground Processing Technical Publications

- **Ground Processing – Flight Hardware, Equipment, & Facilities**
 - “Manufacturing” assembly operations (-not part fabrication)
 - Integration and test
 - In-process maintenance and repair
 - Launch operations
 - Reusable / returnable vehicles also include post-flight activities:
 - Landing and recovery
 - Inspection, refurbishment, maintenance
 - Overhaul, modification, reconfiguration

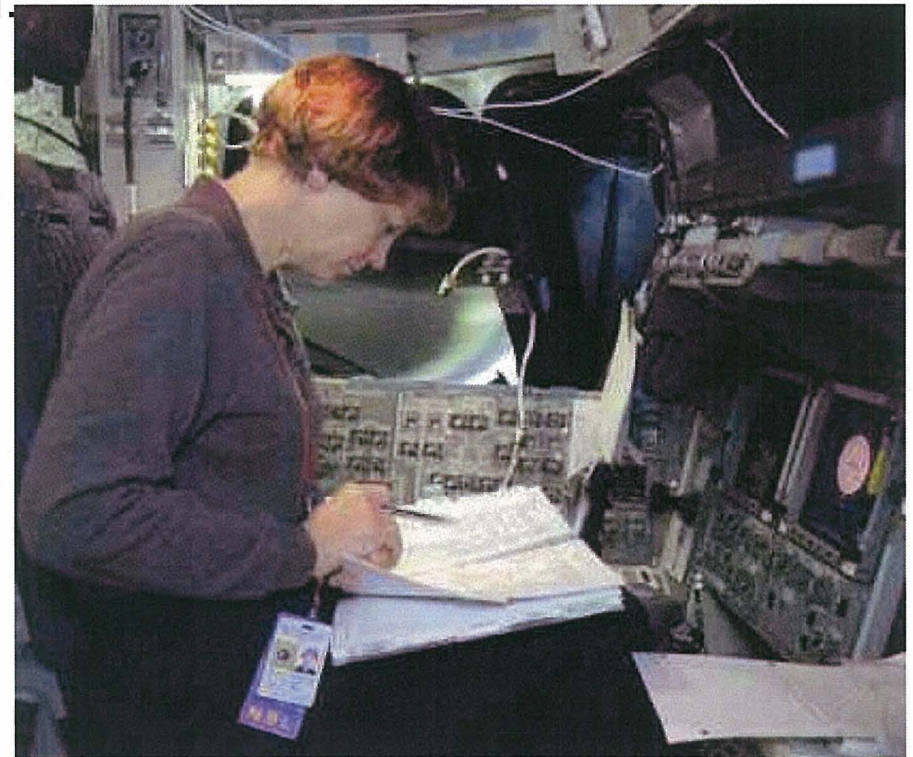


- **Each Facet Often Has Different Technical Publication Types/Sets**

On-Orbit Technical Publications: Shuttle

- **Space Shuttle “Tech Pubs” for Astronauts**

- Used for missions operations by astronauts and ground controllers
- Flight Data Files (FDF)
 - 100% paper manuals/procedures for whole Shuttle program
- Shuttle cockpit “resembles a library” (video)
- Other special procedure types used:
 - Cuff checklists for EVA (spacewalk), on special paper
 - Large collection of cue cards, on cardstock
 - Pocket checklists: 5-min time critical procedures, small size

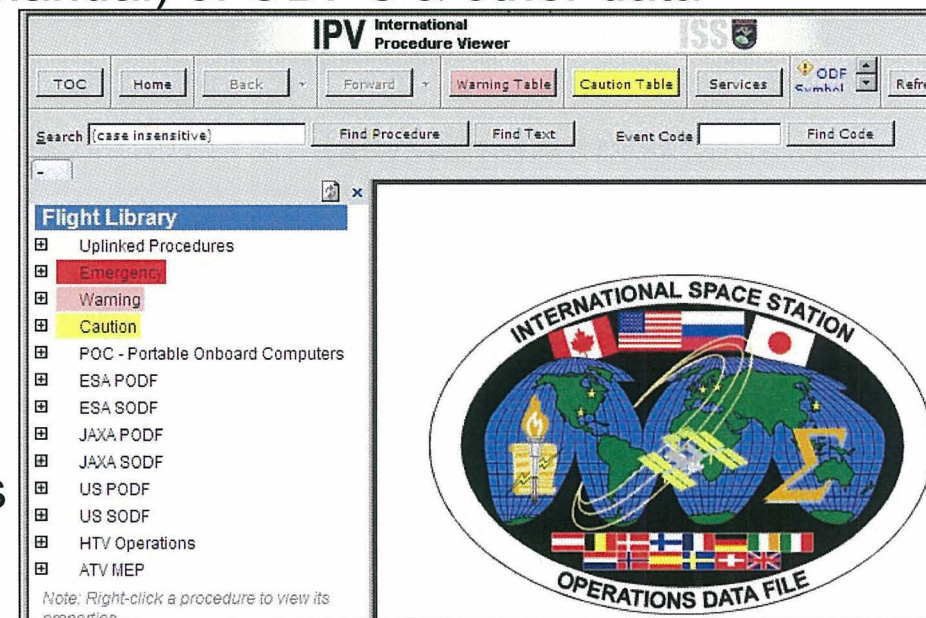


On-Orbit Technical Publications: ISS

- **International Space Station (ISS) “Tech Pubs” for Astronauts**
 - Used to operate, maintain, resupply, including training
- **ODF = Operations Data File**
 - Procedures to operate and maintain ISS systems, payloads, ATV/HTV’s
 - Used by ground controllers, on-board crew, & on-orbit executor software
- **IPV (International Procedure Viewer)**
 - IETM (Interactive Electronic Technical Manual) of ODF’s & other data
 - Used by International Partners (IP)
 - Author ODFs in Word, convert to XML
 - Uses custom XML schema for ODFs

Major Features:

- XML viewer
- Interaction (links, data collection)
- Parameters (Applicability) custom views
- XML tags can enable other applications
 - e.g. – stowage database
- Favorite: Step marker, for placeholder and quick direct scroll to next step



On-Orbit Technical Publications: ISS

• Flight Software Command & Control

- Read commands in IPV, execute on separate flight software display
- European Space Agency (ESA) developed an integration of IPV / ODFs with flight software

- Flight software station has 2 windows in one display
 - ODF step activates a flight display on same screen
 - Execution is a separate click

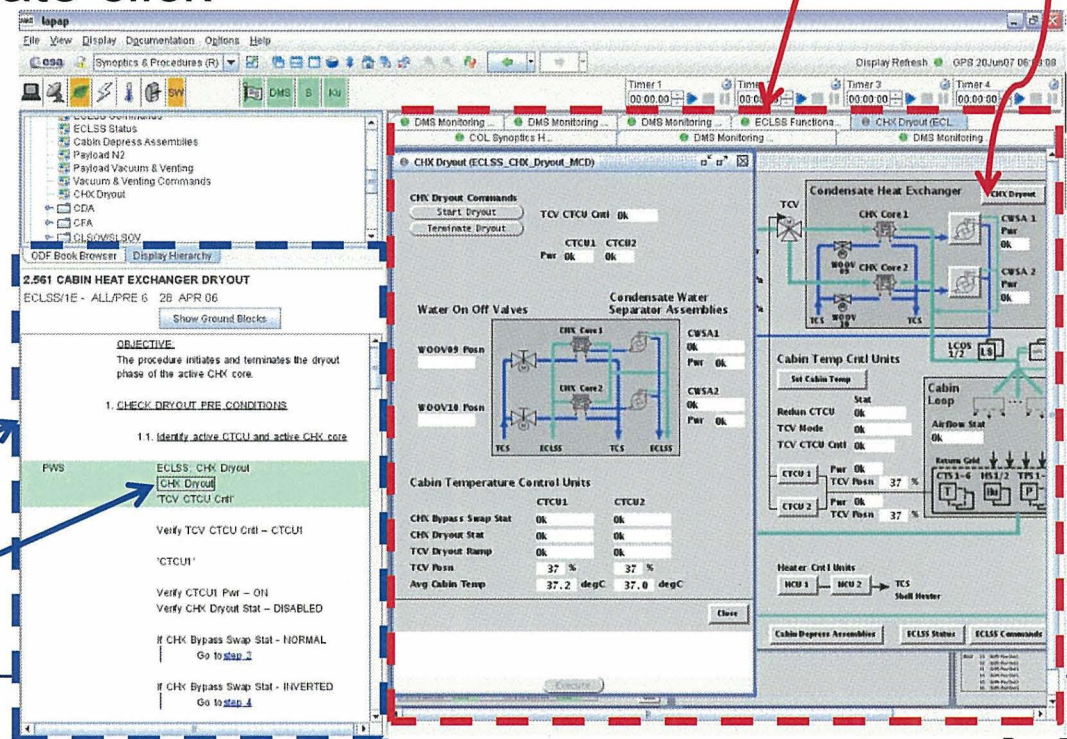
- IPV could directly execute, but does not due to safety concerns
- ESA is evaluating voice-activated commands

Flight software window

Matching command

ODF window

ODF command step



Optimization Via S1000D Standard

- **S1000D—the Next Generation in Tech Pubs**

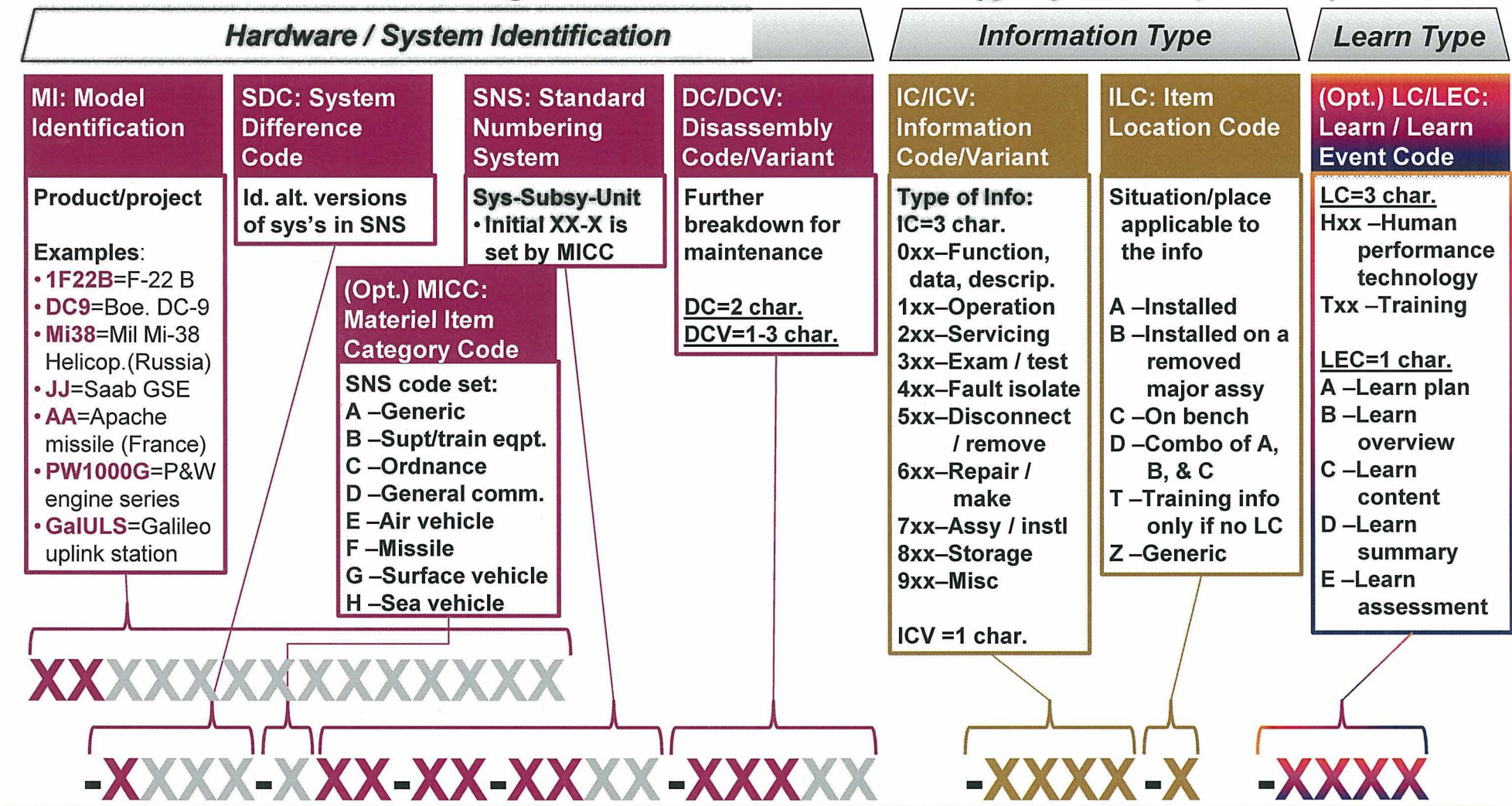
- 1985 European specification now global, via ASD, AIA, & ATA
- Designed for air, land & sea vehicles & equipment—open to more
- Examples of industry use:
 - Boeing 787, Global Hawk, AMRAAM missile, CH148 Cyclone helicopter, EMALS/AAG systems on CVN78 ship

- **S1000D Powerful Features**

- Based on International Standards (W3C, ATA, ISO)
- Electronic Publications (IETM/IETP)
- Standard Numbering System (SNS) Product Breakdown Structure
- Modularity for Reusability / Repurposing
- Common Source Database (CSDB)
- Illustrations, Hotspotting, Multimedia, and CAD
- Applicability—Structured Configuration Varieties
- Business Rules Exchange (BREX)
- XML industry standard – interoperable with other applications

Optimization Via S1000D Standard

- SNS Structure in the S1000D Data Module Code (DMC)
- Variable Character Length: min. 17 to max. 41 (gray X is optional)



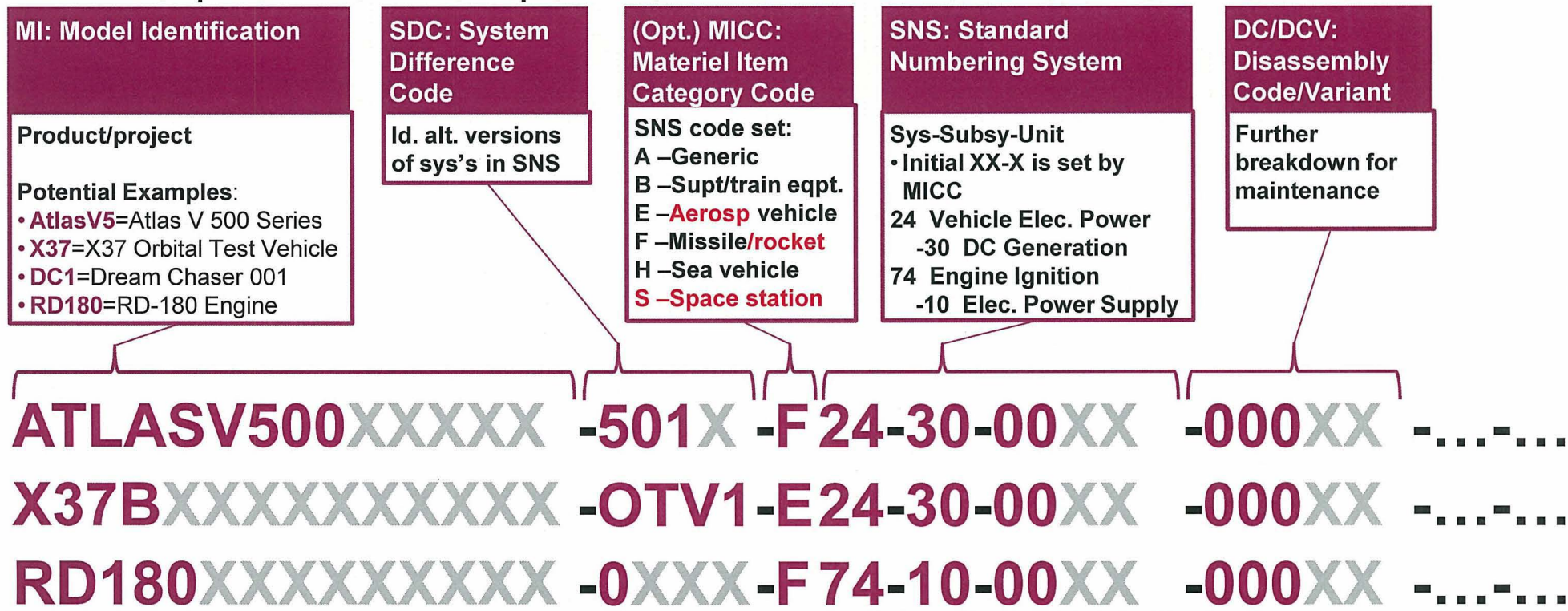
Space Industry Opportunities

• S1000D Known Space Use

- (U.S.) SpaceLift Range System, (Germany) DLR's Galileo satellite ground station, (Italy) ESO's space telescope

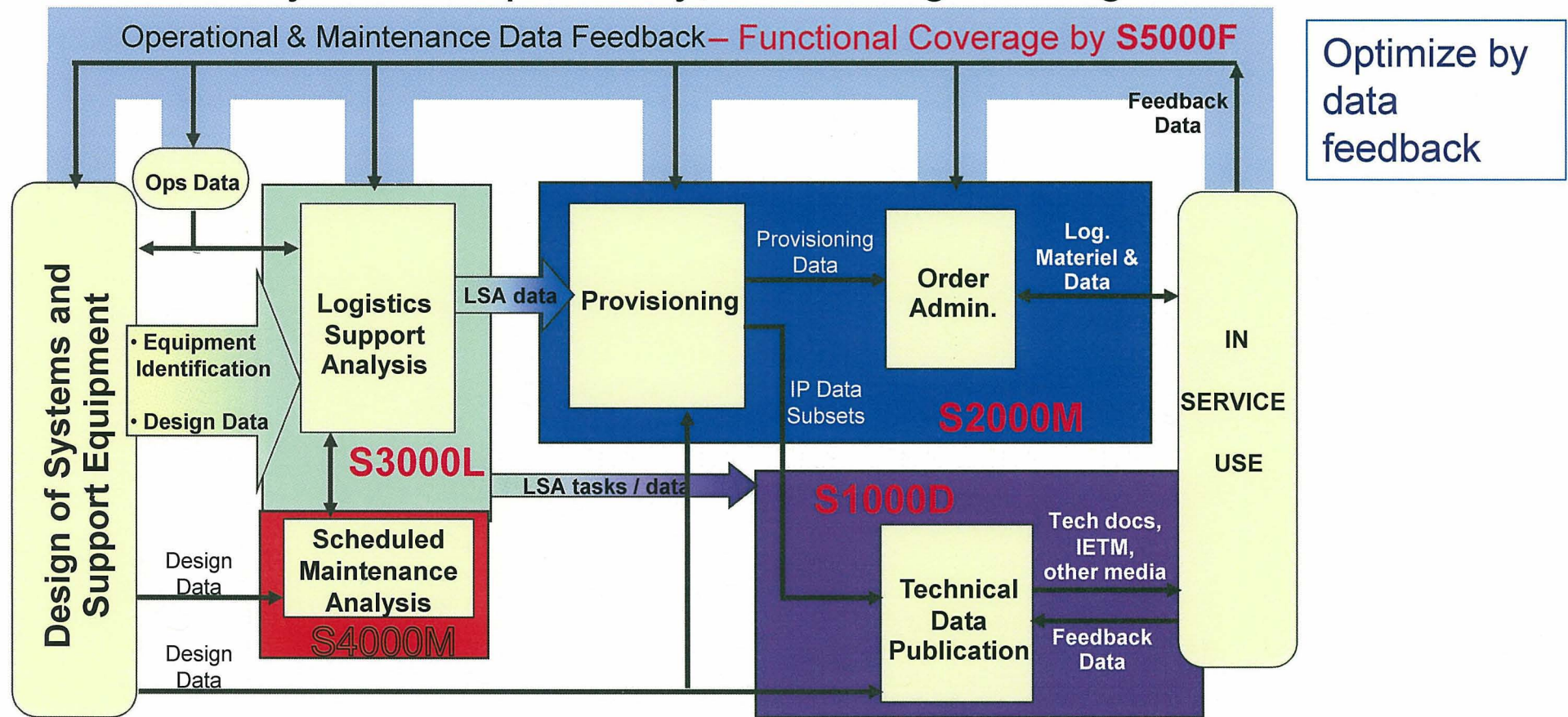
• S1000D Opportunities

- Applicable to any space product: flight hardware, equipment, facilities
- Examples DMC / SNS product breakdown structures, if S1000D is used:



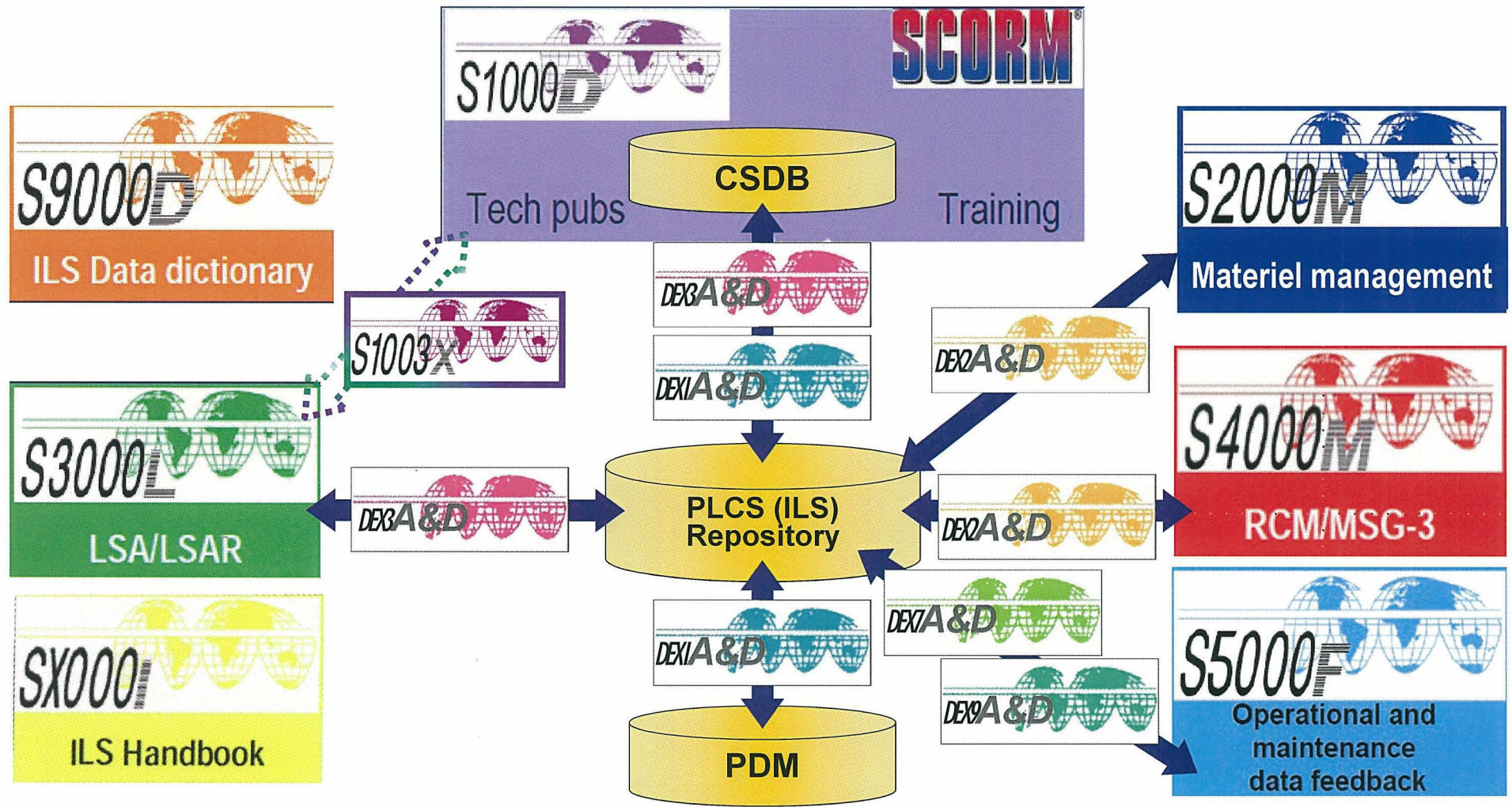
Integration Via Global Standards Suite

- **S-series Specifications (Companions to S1000D)**
 - Jointly managed by Europe's ASD & America's AIA
 - ILS (Integrated Logistics Support)/IPS (Integrated Product Support)
 - Goal: lifecycle interoperability, from design through sustainment



Integration Via Global Standards Suite

- Optimal Efficiencies with IT Integration to Enable Interoperability
- PLCS (Product LifeCycle Support) ISO 10303-239 Standard



Conclusion

- **Efficiency Requires Well-Organized Technical Data**
- **Non-Space Industry Standards Provide Optimized Solutions**
 - Ground processing and flight/mission operations can benefit
 - Standard interfaces with design data are available
 - S1000D for tech pubs: Emerging global standard; some space use
 - S-Series global specifications provide ILS/IPS functionality
 - PLCS standard integrates S-series for optimized interoperability
- **Recommend S-series + PLCS Standards**
- **Space Industry Opportunities**
 - Recommend to expand current ILS/IPS standards efforts
 - Utilize S-series/PLCS for new and some existing space products
 - Join working groups of standards organizations (S-series, PLCS)

***Streamlined Product Support Standards:
Organize, Build Once, Reuse, & Integrate***

Questions?

***“The heart of the prudent acquires knowledge,
And the ear of the wise seeks knowledge.”***

Proverb

QUESTIONS?

Acknowledgements & References

• Acknowledgements

- Michael Hurt, United Space Alliance, LLC, ISS SODF Manager

• References

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BACKUP CHARTS

Integration Via Global Standards Suite

• S-series Specifications



International Specification for Technical Publications



International Specification for Materiel Management



International Procedure Specification for Logistic Support Analysis (LSA)



International Procedural Handbook for Developing Scheduled Maintenance Programs *(-scheduled to release in 2011)*



International Application Handbook for Operational and Maintenance Data Feedback *(-developing to release in 2012)*

• Companion Standards to S1000D

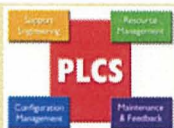


ASD STE 100: Simplified Technical English, International Specification



SCORM (Shareable Content Object Reference Model), a standard for web-based e-learning

• All Can Integrate Via The PLCS Interoperability Standard



ISO 10303-239 Product Life Cycle Support (PLCS)

—part of 10303 STEP standard *(-203=3D config, -233=Sys engr data)*